

LESSON:

Nuclear Energy: Is Perception Reality?

Summary: Students conduct a word association activity to determine how they perceive the dangers and benefits of radiation. Then they read an article about the use of nuclear energy to generate electricity in response to the growing need for electricity and the increase in global warming. Finally, they compare their perceptions with their position on the use of nuclear energy and discuss what role perceptions should play, if any, in the decision-making process for using nuclear energy to generate electricity.

EHP Article: "Power Surge: Renewed Interest in Nuclear Energy"
EHP Student Edition, February 2006, p. A743–A749
<http://ehp.niehs.nih.gov/members/2005/113-11/focus.html>

Objectives: By the end of this lesson students should be able to:

1. conduct a word association experiment;
2. analyze how a person's perceptions affects their decisions; and
3. discuss the role of science and perception in making decisions about environmental risks.

Class Time: 45–60 minutes

Grade Level: 9–12

Subjects Addressed: Environmental Health, Biology, Health

► Prepping the Lesson (15 minutes)

INSTRUCTIONS:

1. Download the entire February 2006 *EHP Student Edition* at <http://ehp.niehs.nih.gov/science-ed/> or download just the article "Power Surge: Renewed Interest in Nuclear Energy" at <http://ehp.niehs.nih.gov/members/2005/113-11/focus.html>.
2. Read the article and review the Background Information and Student Instructions.
3. Make copies of the Student Instructions and the article.
4. Make an overhead of the Class Summary table to record data for each class.

MATERIALS (per student):

- 1 copy of *EHP Student Edition*, February 2006, or 1 copy of "Power Surge: Renewed Interest in Nuclear Energy"
- 1 copy of the Student Instructions

MATERIALS (per class):

- 1 overhead of the Class Summary table

VOCABULARY:

- Global warming
- Nuclear energy
- Perception
- Radiation

BACKGROUND INFORMATION:

People often associate radiation with harmful events, despite its many benefits in diagnosing disease, fixing broken bones, finding cavities in teeth, treating cancer, and generating electricity. A survey by The Gallup Organization in 1991 (Bisconti and Livingston, 1992) asked 1,020 adults "When you hear the word 'radiation,' what are some of the things that come to mind?" The results showed that negative free associations predominated. Thirty-six percent of the respondents associated radiation



with bodily harm (cancer, death, sickness, and burns), 21% with destruction and danger, and 21% with nuclear war and bombs. Sixty percent of the respondents reported one or more negative associations. The most frequently cited benefit for radiation was cancer treatment, X-rays, other medical applications, and nuclear power/energy.

Some advocates of nuclear energy believe that peoples' fears of nuclear energy exaggerate the actual risks beyond what science predicts. For example, science says one receives much more radiation from fertilizing the lawn (fertilizer contains radioactive potassium-40), living next to a coal-fired power plant (due to radioactive ash from the coal), flying from New York to Los Angeles (due to cosmic radiation), or getting a chest X-ray than one would typically receive while living next to a nuclear energy plant. Studies of people's perception of environmental risks have shown that people consider other factors in making decisions about environmental risks besides the scientific risk or probability that something will happen. Some of the factors people consider include whether an exposure is involuntary; whether it comes from an industrial source; and whether it is exotic, memorable, dreaded, catastrophic, unforeseeable, or controlled by others (refer to the Background Information section of the November 2005 *EHP Student Edition* lesson "GM Foods: Are the Risks Real?" for more information on risk perception). It is not clear how or to what extent people's perception of risk and scientific risk should be taken into account when making decisions about environmental risks. This lesson asks students to identify their perceptions about radiation and analyze how their perceptions affect their position on using nuclear power to generate electricity.

REFERENCE:

Bisconti AS, Livingston RL. 1992. Communicating With the Public About Radiation: An Assessment of Public Attitudes About Radiation, and Their Implications for Communication and Education Programs. Washington, DC: U.S. Council for Energy Awareness

RESOURCES:

Environmental Health Perspectives, Environews by Topic page, <http://ehp.niehs.nih.gov/topic>. Choose Energy, Radiation/Radioactivity

Environmental Literacy Council. 2005. Nuclear energy, <http://www.enviroliteracy.org/subcategory.php/28.html>

GM Foods: Are the Risks Real? *EHP Student Edition*, November 2005, <http://ehp.niehs.nih.gov/science-ed/2005/gmfood.pdf>

Holmes H. 1997. Why we fear nuclear power, not peanut butter, <http://www.discovery.com/area/skinnyon/skinnyon970212/skinny1.html>

Massachusetts Institute of Technology. 2003. The Future of nuclear energy: an interdisciplinary MIT study, <http://web.mit.edu/nuclearpower/>

Public Broadcasting Service. 1997. Nuclear reaction: why do Americans fear nuclear power?, <http://www.pbs.org/wgbh/pages/frontline/shows/reaction/>

► Implementing the Lesson

INSTRUCTIONS:

1. Introduce the lesson by telling students they will conduct an activity to determine their perceptions about radiation.
2. Hand out the Student Instructions and the article "Power Surge: Renewed Interest in Nuclear Energy."
3. Have students complete Steps 1 and 2 as individuals. Then as a class, combine the individual results and discuss as part of Step 3.
4. Ask students to complete Step 4 as individuals. Then as a class, combine the individual results and again discuss as part of Step 5.
5. Finally, as a class, discuss the questions in Step 6 (see Assessing the Lesson for points of discussion).

NOTES & HELPFUL HINTS:

- The lesson could be expanded by having a class debate for and against the use of nuclear power.
- Students could investigate the construction cost and per-capita output for a nuclear power plant and compare those the costs and energy output by energy production from solar and wind power. *EHP* has many articles to refer to at <http://ehp.niehs.nih.gov/topic/energy.html>.
- Students could investigate the source(s) of energy in their community by asking their local utility company about the percentage of their energy that comes from a coal-fired power plant, a nuclear plant, or other source.



► Aligning with Standards

SKILLS USED OR DEVELOPED:

- Classification
- Communication (oral, written—including summarization)
- Comprehension (listening, reading)
- Critical thinking and response
- Experimentation (conducting, data analysis)
- Tables (creating, reading)
- Research

SPECIFIC CONTENT ADDRESSED:

- Perceptions about radiation
- Nuclear power
- Role of science in making decisions about environmental risks

NATIONAL SCIENCE EDUCATION CONTENT STANDARDS MET:

Unifying Concepts and Processes Standard

- Systems, order, and organization
- Evidence, models, and explanation

Science As Inquiry Standard

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Science and Technology Standard

- Abilities of technical design
- Understanding about science and technology

Science in Personal and Social Perspectives Standard

- Personal and community health
- Natural resources
- Environmental quality
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

► Assessing the Lesson

Step 1: In the first column, write five things that come to mind when you hear the word “radiation.”

Responses will vary. Possible responses might include the following: cancer, death, sickness, burns, radiation poison, X-rays, cancer treatment, treatment, dangerous, harmful, waste, destruction, nuclear accidents, bombs, explosion, nuclear war, nuclear weapons, fallout, nuclear power, energy, sun, radon, heat, microwaves, fear, TV, and high power lines.

Step 2: Classify each item you listed according to one of the following three categories: dangers of radiation, benefits of radiation, and neutral about radiation. Write your answers in column 2 in the table above. Which category had the most responses? Explain why you think you gave more responses in that category.

Responses will vary. It is expected that there will be more responses pointing out the dangers. Reasons why might be related to TV, movies, news articles, and/or personal experiences. Some students may indicate it is a simple emotional reaction and that they are not sure why they responded the way they did. Some students may point out that there are known health dangers of radiation.

Step 3: As a class, count up all of the individual responses for each of the categories: dangers, benefits, and neutral. Convert the number of responses in each category to a percentage of the class. Which category had the highest-percentage response? Why do you think you got these results?

Responses will vary. It is expected that the class will have more responses pointing out the dangers. Class reasons for why the class gave their responses would be similar to why individuals selected their responses (see Step 2).



Step 4: Read the article “Power Surge: Renewed Interest in Nuclear Energy.” Decide whether you support or oppose the use of nuclear energy to generate electricity. How does your position on nuclear energy compare with your results from Step 2?

Responses will vary.

Step 5: As a class, count up the votes for and against the use of nuclear energy to generate electricity. How does the class vote compare with the class results from Step 3?

Responses will vary. It is expected that the percentage of votes against nuclear power will be similar to the percentage indicating radiation is dangerous. If there is a difference between the percentage against nuclear power and the percentage indicating radiation is dangerous, this may be worth exploring with the students. Why might there be a difference? What factors contribute to a more or less favorable perception of one or the other?

Step 6: As a class, discuss the following questions:

1. Is there any additional information you would need in order to make an educated decision about using nuclear energy?

Responses will vary. Responses may include: How much does it cost to build, run, and maintain nuclear power plants compared to other noncombustion energy options? How much does it cost to dispose of nuclear waste? Are there sufficient and safe disposal locations? How much nuclear waste is produced in a given period of time? How much does nuclear energy cost the consumer over time compared to other sources of energy? What are the health risks from spills, transport, and storage of waste? What are the health risks from nuclear energy compared to the potential impacts of global warming?

2. Do people’s perceptions about radiation influence their position on using nuclear energy to generate electricity?

Responses will vary. It is expected that students will conclude that people’s perceptions of risks influences where they stand on the issue.

3. Are people’s perceptions about radiation based on scientific facts?

Responses will vary. It is expected that students will conclude that people’s perceptions of risks are not always based on scientific facts and are influenced by other factors.

4. What role, if any, should people’s perception play in making a decision about the use of nuclear energy to generate electricity?

Responses will vary. It is expected that students will support the need for science to help guide decisions about the issue but will conclude that peoples’ perceptions should also be considered somehow.

5. Do you think people’s perceptions on using nuclear energy would change if it is used halfway across the world compared to in their own community?

Responses will vary. Students may be less concerned with the use of nuclear energy if it is not in their community. You may want to guide the discussion by having the students look at the photo on page A748 of the article and asking what they think of it. What does the photo say about the reality of having a nuclear power plant in your backyard?

► Authors and Reviewers

Authors: Barry Schlegel and Laura Hemminger, University of Medicine and Dentistry of New Jersey

Reviewers: Susan Booker, Stefani Hines, Liam O’Fallon, Kimberly Thigpen Tart, Tanya Tillett, Heather Valli



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Step 1: In column 1 below, write five things that come to mind when you hear the word “radiation.”

Column 1 Things that come to mind when you hear the word “radiation”	Column 2 Classification
1.	
2.	
3.	
4.	
5.	

Step 2: Classify each item you listed according to one of three categories: dangers of radiation, benefits of radiation, and neutral about radiation. Write your answers in column 2 above. Which category had the most responses? Explain why you think you gave more responses in that category.

Step 3: As a class, count up all of the individual responses for each of the categories: dangers, benefits, and neutral. Convert the number of responses in each category to a percentage of the class. Which category had the highest-percentage response? Why do you think you got these results?

Step 4: Read the article “Power Surge: Renewed Interest in Nuclear Energy.” Decide whether you support or oppose the use of nuclear energy to generate electricity. How does your position on nuclear energy compare with your results from Step 2?

Step 5: As a class, count up the votes for and against the use of nuclear energy to generate electricity. How does the class vote compare with the class results from Step 3?



Step 6: As a class, discuss the following questions:

1. Is there any additional information you would need in order to make an educated decision about using nuclear energy?
2. Do people's perceptions about radiation influence their position on using nuclear energy to generate electricity?
3. Are people's perceptions about radiation based on scientific facts?
4. What role, if any, should people's perception play in making a decision about the use of nuclear energy to generate electricity?
5. Do you think people's perceptions on using nuclear energy would change if it is used halfway across the world compared to in their own community?



**Nuclear Energy: Is Perception Reality?
Class Summary**

Class Period		Word Associations			Use of Nuclear Power	
		Dangers	Benefits	Neutral	For	Against
1	#					
	%					
2	#					
	%					
3	#					
	%					
4	#					
	%					
5	#					
	%					
6	#					
	%					
Total All Classes	#					
	%					

